

(57) Abstract: The present invention relates to a package (40) of the bag-in-box (or bag-in-barrel) type. The package (40) includes a bag (46) which when filled with contents, which may be liquid or semi-liquid, so that these contents could move about (i.e., slosh) during shipping and handling of the package (40) except for the provision of a dunnage apparatus (52) of the package. The dunnage apparatus (52) controls movements of the contents of the package (40), or isolates at least a part of the bag (46) from the effects of this movement.

Package and Method

Background of the Invention

Field of the Invention

This invention is in the field of packages and methods of packaging. More particularly, this invention relates to methods and apparatus for preventing the contents of a package (i.e., such as liquid or semi-liquid contents) from moving to and fro (i.e., sloshing) as the package is moved, such as during shipment. Still more particularly, this invention relates to methods and apparatus for preventing a liquid-holding bag (which is held within a container, the bag and container together defining a package), from being fatigued by continual flexing of the bag resulting from movements of the contents of the package.

Related Technology

A conventional package is known in accord with United States patent No. 5,046,634, issued 10 September 1991, to George P. McFarlin, and Chester Savage (a coinventor of the present invention), and assigned to the same assignee as this application. The '634 patent is believed to relate to a plastic bag with a particularly configured fitting which is used as a drum liner to make a package. In use of this bag, it is placed into engagement with a specially configured bung hole of the lid of a steel drum, and the drum is sealed, after which the bag is inflated and a vent hole of the drum lid is sealed. With the vent hole of the drum lid sealed, the plastic bag is prevented from collapsing into the interior of the drum. Consequently, the drum may be filled and emptied without pockets or wrinkles of the bag retaining any of the contents of the package.

United States patent No. 5,454,407 issued 3 October 1995, to Mark Huza, Michael Pesce, and Jack M. Olich, is believed to relate to a pneumatic wand device for automatically filling a non-elastic dunnage bag with a predetermined pressure of pressurized ambient air.

United States patent No. 5,806,572, issued 15 September 1998, to Ronald L. Voller, is believed to relate to an inflatable dunnage bag, and apparatus for inflating and deflating the dunnage bag to assist in preventing cargo from shifting during transport, for example, as within the trailer of a cargo truck.

Figures 28-30 in conjunction illustrate a conventional bag-in-box package 10, which outwardly has the form of a crate 12 mounted to a pallet 14. The crate 12 includes a removable lid 12a, which is held in place during storage and shipping of the filled package by bands 12b (indicated by an arrow on Figure 29). This package 12 defines an interior chamber 12c, within which is disposed a plastic bag 16. Most usually, this bag 16 is of the "lay flat" type. The

plastic bag 16 includes a wall 16', and a fitting 16a with a removable cap 16b. By removing the cap 16b access to the internal chamber 16c of the bag 16 is gained. That is, when the cap 16b is removed from the fitting 16a, then liquid and semi-liquid contents 16c' may be flowed into and out of the bag 16 via a through passage (not seen in the drawing Figures) defined by fitting 16a and opening into the bag 16. On the other hand, when the cap 16b is placed on fitting 16a, then the contents 16c' of the bag are protected from environmental contamination, including bacterial contamination.

The bag 16 may be filled, for example, with liquid or semi-liquid product 16c' (such as a food product, or a non-food product) to be shipped or stored in the package 10. When so filled, the bag 16 becomes generally conformal to the inside shape of the chamber 12c of the crate 12. It will be noted that the filled bag 16 as seen in Figure 29 does not fill or occupy the entire volume of chamber 12c. Thus, an ullage volume 18 is defined within the chamber 12c above the filled bag 16. As Figure 30 illustrates, the bag 16 also may not fit perfectly into the inside corners of the crate 12, so that an additional ullage space 18a is defined between the inside corners of the crate 12 and the bag 16.

Understandably, because the contents 16c' of bag 16 are liquid or semi-liquid, these contents 16c' of bag 16 are able to flow and slosh to and fro within the chamber 12c as the package 12 is moved during storage or shipping. This sloshing of the contents 16c' of package 10 is illustrated in Figure 29 by arrows 20. Further, the sloshing 20 of contents 16c' of bag 16 are seen in Figure 30 to slosh into and out of the inside corners of the crate 12. Particularly at the inside corners of the crate 12, but also at other areas of the bag 16 as well, the sloshing 20 of contents 16c' repeatedly flexes, stresses, and possibly fatigues the wall 16' of bag 16. Because of this repeated and continual stressing and flexing of the wall 16', this wall must be made heavier and thicker than is desired in order to prevent fatigue cracking and fissuring of the bag 16. That is, the entire bag 16 is made of material for wall 16' that is more expensive than is desired in order to prevent fatigue failures of this bag caused by sloshing of the contents of the bag.

Figure 31 illustrates another conventional bag-in-container package 22, which in this instance outwardly takes the form of a barrel. The barrel 22 may be formed of metal, as illustrated (i.e., a typical 55 gallon steel drum), or may be formed, for example, of fiberboard. The package 22 includes a removable lid 24, which is held to the body of the barrel by a clamp band 24a. Within the barrel 22 is held a plastic bag 26, which is shown in its as-manufactured, un-filled, and flat condition in Figure 32. The plastic bag 26 is also of a "lay flat" configuration. In other words, the bag 26 is manufactured as a flat assemblage of two

opposing walls 26a formed of plastic sheeting (which may be a laminated sheeting of two or more plies), which are heat bonded together near the periphery of these walls 26a to form a seam 26b (seen in Figures 31 and 32). Again, this bag 26 is provided with a fitting 28 having a removable cap 28a, by which access to the inside of this bag 26 is gained for filling and emptying of the bag. As Figure 33 illustrates, the filled bag 26 does not completely fill the interior volume of the barrel 28, so that an ullage volume 30 is defined between the bag 26 and lid 24.

Because of movements and accelerations that the package 28 experiences during shipping and handling, the contents of the bag 26 slosh about in the volume 30 (arrows 32 on Figure 33). Consequently, the walls 26a of bag 26 will have areas near the ullage volume 30, which are repeatedly and continually flexed, stressed and possibly fatigued by the sloshing 32 of the contents of bag 26. Again, because of this possible fatiguing of bag 26, the entire bag must be made of a material that is more expensive than desired.

In view of the above, it is seen that the prior art teaches to make bags, such as bag 16 and bag 26, which are more expensive than is desired just to avoid a possible fatigue failure of the bag. This is true even though only a relatively small portion of the bags is subjected to possible fatigue failure. Thus, with conventional bags for bag-in-container packages, the entire bag is more expensive than is desired to avoid a possible failure of a relatively small part of the bag.

Brief Description of the Drawing Figures

Figure 1 provides a fragmentary view, partly in cross section, of a package embodying the present invention;

Figure 2 provides a view similar to that of Figure 1, but showing the package before inflation of a dunnage apparatus, which forms a part of the package;

Figure 3 provides a plan view of the dunnage apparatus seen in the package of Figures 1 and 2;

Figure 4 is a fragmentary cross sectional view of a portion of the dunnage apparatus seen in Figure 3;

Figure 5 provides a plan view, similar to that of Figure 3, but showing an alternative embodiment of a dunnage apparatus intended to be used as part of a package like that illustrated by Figures 1 and 2;

Figure 6 provides an elevation view, partly in cross section, of another embodiment of a package including a dunnage apparatus embodying the present invention;

Figure 7 is a plan view of the dunnage apparatus seen in the embodiment of package illustrated in Figure 6;

Figure 8 provides an exploded perspective view of the dunnage apparatus seen in Figures 6 and 7;

5 Figure 9 is a fragmentary cross sectional view of a portion of the dunnage apparatus seen in Figures 6-8, and is shown at a much enlarged size compared to Figures 6-8;

Figure 10 is a fragmentary cross sectional view of a portion of the dunnage apparatus seen in Figures 6-9, but is seen in Figure 10 at a further enlarged size;

10 Figure 11 is an exploded perspective view of a portion of the dunnage apparatus seen in Figures 6-9;

Figure 12 provides a plan view of another alternative embodiment of a dunnage apparatus embodying the present invention, which apparatus is shown in a deflated condition;

Figure 13 shows the dunnage apparatus of Figure 12 inflated and in perspective view;

15 Figure 14 provides a plan view of another alternative embodiment of a dunnage apparatus embodying the present invention;

Figure 15 is a side elevation view of a package embodying yet another embodiment of the present invention;

Figure 16 provides a fragmentary side elevation view of a dunnage apparatus seen in the package of Figure 15;

20 Figure 17 provides a side elevation view of yet another package embodying the present invention;

Figure 18 provides a perspective view of yet another embodiment of a dunnage apparatus according to the present invention;

Figure 19 is a cross sectional view of the dunnage apparatus seen in Figure 19;

25 Figure 20 is a perspective view of a package embodying the present invention;

Figure 21 provides a fragmentary cross sectional view of a portion of the package seen in Figure 20;

Figure 22 is a cross sectional elevation view similar to Figure 6, but showing an alternative embodiment of the invention;

30 Figure 23 provides a plan view, partially in cross section taken at the line indicated by the arrowed line 23-23 on Figure 22, of the package seen in Figure 22;

Figure 24 is a perspective view of a component of the package seen in Figures 22 and 23, and of an article of manufacture which may be used to constitute such a package;

Figure 25 provides a perspective view of yet another alternative embodiment of a package according to the present invention, and which is somewhat similar to the package of Figure 1;

Figure 26 is an enlarged fragmentary view of a portion of the package seen in Figure 25;

Figure 27 is an enlarged fragmentary view of the same portion of the package of Figure 25 as is seen in Figure 26, and is shown in an alternative operative configuration; and

Figures 28 – 33 illustrate prior art packages.

Detailed Description of Preferred Exemplary Embodiments of the Invention

Turning now to Figures 1-4, in conjunction illustrate an embodiment of a bag-in-box package 40 according to the present invention. Outwardly, this package 40 has the form of a crate 42 mounted to a pallet 44. The crate 42 includes a removable lid 42a, which is held in place during storage and shipping of the filled package by bands 42b. The package 42 defines an interior chamber 42c, within which is disposed a plastic bag 46. The plastic bag 46 in this case may be conventional, and may include a wall 46', and a fitting (not seen in Figures 1-4) with a removable cap (also not seen in the drawing Figures). Particularly, the plastic bag 46 may be a conventional "lay flat" type of bag. The bag 46 defines an internal chamber 46c, within which liquid or semi-liquid contents (also indicated by the numeral 46c) may be placed via the fitting of this bag 46.

When filled, the bag 46 becomes generally conformal to the inside shape of the chamber 42c of the crate 42, as is conventional. Again, it will be noted that the filled bag 46 as seen in Figure 1 (and particularly in Figure 2) does not fill or occupy the entire volume of chamber 42c. Thus, an ullage volume 48 is defined within the chamber 42c above the filled bag 46. Again, as was seen in Figures 22, 23, and 24, the bag 46 does not fit perfectly into the inside corners of the crate 12, so that an additional ullage space 48a is defined between the inside corners of the crate 42 and the bag 16. Again, because the contents 46c of bag 46 are liquid or semi-liquid, these contents 46c would be able to flow and slosh to and fro within the chamber 42c as the package 42 is moved during storage or shipping, as is illustrated in Figures 1 and 2 by arrows 50.

However, the package 40 also includes a dunnage apparatus 52, which substantially prevents the sloshing 50 of contents 46c. Viewing Figures 1-4 in conjunction with one another, and viewing particularly Figure 1, it is seen that the dunnage apparatus 52 has a generally rectangular plan-form shape 52a (best seen in Figure 3), and is formed to include

upper and lower generally planar walls 52b. As will be seen, the walls 52b may be formed of rectangular plastic sheets. The plastic sheet walls 52b may be a single ply or may include more than one ply. Preferably, the sheet walls 52b are bonded to one another at bond areas indicated with the arrowed numeral 52c. Although the invention is not so limited, the sheet walls 52b may be thermally bonded to one another. Consequently, the dunnage apparatus 52 defines plural inflatable chambers 54 (shown inflated in Figure 1). Dunnage apparatus 52 is shown in Figure 2 in its deflated condition disposed atop the filled bag 46 in preparation for inflation of the apparatus 52.

The dunnage apparatus 52 is seen in Figures 2 and 3 to have a rectangular shape in plan view, which shape substantially matches the plan-view shape of the chamber 42c, and of the filled bag 46. As is seen in Figure 1, the chambers 54 of the dunnage apparatus are inflated with pressurized ambient air. The chambers 54 communicate with one another for inflation, but once inflated are in air-flow isolation from one another. As inflated, the dunnage apparatus 52 substantially fills the ullage volume 48, and substantially prevents sloshing of contents 46c of bag 46. Because sloshing of the contents 46c is substantially prevented by dunnage apparatus 52, the bag 46 may be made lighter and thinner than conventional bags with no increased risk of this bag failing because of fatigue of the bag. In fact, with the present invention, the risk of a fatigue failure of the bag 46 is actually reduced even with a lighter, thinner, and less expensive bag because sloshing of the contents 46c, and the attendant stressing and fatiguing of the bag 46, is substantially prevented.

Considering Figures 1-4 in particular detail, it is seen that the dunnage apparatus 52 includes an inflation air inlet fitting 56, which is aligned with and is receivable into an opening 58 of the lid 42a of the package 42. Thus, as is illustrated in Figure 2, a pressurizing air nozzle (indicated by arrow 60) may be introduced to the fitting 56 through the opening 58 of lid 42a. The pressurized air 60 is introduced into apparatus 52 after the lid 42a has been secured on the crate 42 (i.e., with the bag 46 filled with contents 46c), and after the dunnage apparatus 52 has been laid into the ullage volume 48 atop the filled bag 46. As is best seen in Figure 3, the dunnage apparatus 52 includes an integral manifold structure, indicated by the arrowed numeral 62, and which defines a plenum chamber 62a communicating pressurized air (as is indicated by arrowed numerals 60a) from fitting 56 to a plurality of non-return valves 64. The non-return valves 64 individually communicate pressurized air into the chambers 54, but prevent outflow of this pressurized air.

Figure 4 illustrates that the non-return valves 64 are formed by an opposing pair of sheets 64a and 64b, at least one of which is flexible, and which together extend from the

manifold 62a into a respective one of the chambers 54. Because these sheets 64a and 64b are outwardly exposed to the air pressure in the chamber 54, while being inwardly exposed to the air pressure in manifold 62a, and because these sheets can sealingly engage one another or disengage from one another in response to an air pressure differential between the manifold 62a and chamber 54, it follows that air can flow into chamber 54 via the valve 64, but cannot back-flow.

Consequently, as air flows into fitting 56 and to the individual chambers 54, the dunnage apparatus 52 inflates and expands in the vertical direction from its position as seen in Figure 2, to take up the position seen in Figure 1. As the dunnage apparatus 52 inflates, the ullage volume 48 (as is seen in Figure 2) is filled by the inflating dunnage apparatus 52 (referring to Figure 1). When the dunnage apparatus 52 substantially fills the ullage volume 48, then a selected overpressure of pressurized air is applied via the fitting 56 into the chambers 54 so that these chambers have both a pressure that is applied to the contents 46c of the bag 46, and a resilience which allows some accommodation of further settling of the contents 46c, as well as expansion and contraction of the package and contents in response to temperature changes. Importantly, because of the overpressure applied to the chambers 54 even if the contents 46c of the package 12 settle the chambers 54 of the dunnage apparatus 52 just expand in compensation to ensure that sloshing of the contents 46c is substantially prevented.

Also, very importantly, the dunnage apparatus 52 is sub-divided into plural chambers 54, each of which has a non-return fluid flow relationship with the fluid flow manifold allowing these chambers to be inflated simultaneously. This non-return feature of the apparatus 52 prevents sloshing of the contents 46c from simply displacing pressurized air from one of the chambers 54 into another of the chambers 54 (i.e., which would allow sloshing to still take place).

As Figure 3 illustrates, the embodiment of the dunnage apparatus seen in Figures 1-4 is subdivided into a rectangular grid or array, with each of the inflatable chambers 54 being rectangular and cooperatively filling substantially all of the area of the dunnage apparatus 52 when seen in plan view. That is, except for the plan area required for the fitting 56 and manifold 62, the inflatable chambers 54 substantially fill the plan area of the dunnage apparatus 52, viewing Figure 3. It will be recalled that the dunnage apparatus 52 is configured to be substantially congruent with (i.e., to substantially cover) the ullage volume 48 when seen in plan. Thus, when the dunnage apparatus 52 is inflated as is seen in Figure 1, there is only a very small area or volume of the ullage volume 48 that is not controlled by the apparatus 52 to

substantially prevent sloshing of the contents 46c. This uncontrolled area or volume in the embodiment of Figures 1-4 is generally at the manifold 62, which is centrally located in plan view of the crate 42, so that not much sloshing of the contents 46c can result from this uncontrolled area.

5 However, Figure 5 shows in plan view another embodiment of a dunnage apparatus for a package like package 40 (i.e., a package which is rectangular in plan view) and in which there is only a very small and centrally located uncontrolled area of the ullage volume. In order to obtain reference numerals for use in describing the embodiment of Figure 5, features which are the same as or which are analogous to features depicted and described above, are
10 referenced on Figure 5 with the same numeral used above, and increased by one-hundred (100).

 Considering Figure 5, it is seen that a dunnage apparatus 152 includes a centrally located inflation air inlet fitting 156. As with the embodiment of Figures 1-4, the fitting 156 will be aligned with and received into an opening of the lid of a package (i.e., like package 42)
15 which is using the dunnage apparatus 152. However, the fitting 156 is centrally located on the dunnage apparatus 152 (i.e., at the intersection of diagonals of the generally rectangular plan-view shape of the apparatus). Also, the dunnage apparatus 152 includes an integral centrally located manifold structure 162, which defines a plenum chamber 162a communicating pressurized air (as is indicated by arrowed numerals 160a) from fitting 156 to a plurality of
20 non-return valves 164. In this case, the non-return valves 164 are all disposed radially outwardly with respect to the centrally located fitting 156. As with the embodiment of Figures 1-4, each of the non-return valves 164 individually communicates pressurized air into a respective one of the plural chambers 154, and also prevents outflow of this pressurized air. In the case of the embodiment of Figure 5, however, the chambers 154 are segment shaped and
25 are separated from one another by radially extending seal lines 152b.

 In view of the above, it is easily seen that the dunnage apparatus 152, when inflated, will provide eight radially extending chambers 54, each of which will extend radially outwardly to adjacent the outer extent of the ullage volume of the package in which this dunnage apparatus is used. Only the extreme center of the ullage volume of a package using
30 the dunnage apparatus 152 will not be constrained by an inflated chamber 154, and this central area of the ullage volume does not present a significant problem so far a sloshing of the contents of the package is concerned.

 Figures 6-11 illustrate another embodiment of a package 72 according to the present invention. In this instance the apparatus is configured for use with a bag-in-container package

taking the form of a barrel. Again, the barrel may be formed of metal, as illustrated (i.e., a typical 55 gallon steel drum), or may be formed, for example, of fiberboard. The package 72 includes a removable lid 74, which is held to the body of the barrel by a clamp band 74a. The lid 74 is provided with a central opening 74c. Within the barrel 72 is held a plastic bag 76, which may have an appearance the same as the bag seen in Figure 27. However, as will be appreciated, the bag 76 in the package 72 may be less expensive than the bags used in conventional packages of the prior art. In this case, the bag 76 is disposed with its fitting 78 centrally located in the package 72. Above the filled bag 76 in package 72 is an ullage volume 80.

Disposed in this ullage volume 80 is a dunnage apparatus 252 according to the present invention. Because the dunnage apparatus 252 has several features and functions in common with the apparatus 52 and 152, these features are indicated on Figures 6-11 using the same numeral used above with reference to Figures 1-4, but increased by two-hundred (200). The dunnage apparatus 252 will be seen to include plural inflatable chambers 254, which chambers are in flow isolation from one another once inflated, and which sub-divide the plan view of the package 72 to substantially prevent sloshing of the contents of the package. The dunnage apparatus 252 substantially prevents sloshing of the contents of package 72, as will be further explained.

Viewing Figures 6-11 in conjunction with one another, and viewing particularly Figures 7 and 8, it is seen that the dunnage apparatus 252 has a generally circular plan-form shape 252a (i.e., generally matching the plan-form shape of the package 72). As with the embodiments depicted and described earlier, the apparatus 252 is formed of upper and lower generally planar circular plastic sheets 252b (best seen in Figure 8). The plastic sheets 252b may each be a single ply or may include more than one ply. Preferably, the sheets 252b are bonded to one another at bond areas indicated with the arrowed numeral 252c. Consequently, the dunnage apparatus 252 defines plural radially extending inflatable chambers 254 (similarly to the embodiment of Figure 5). These inflatable chambers 254 are shown inflated in Figure 6, with the dunnage apparatus 252 being disposed within the ullage volume 80 atop the filled bag 76 in order to substantially prevent sloshing of the contents 76c of the package.

As is best seen in Figures 8, 10, and 11, the non-return valves 264 are in this case also made of two congruent and opposed flexible sheets 264a/b. However, disposed between these flexible sheets 264a/b is a shape-retaining flow distribution member 82. This flow distribution member 82 may include an upwardly extending tubular section 82a, which in the finished dunnage apparatus 252 (as is best seen in Figure 7) defines the outwardly accessible fitting 256

for use in filling the dunnage apparatus with pressurized air. It will be understood that the tubular section 82a may be integral with the shape-retaining flow distribution member 82, or that it may be a separate part which is sealingly bonded to this flow distribution member at a bond area 82b, as is illustrated in Figure 8.

5 Further, the flow distribution member 82 has an arched or arcuate shape when seen in cross sectional or end view (see, Figure 10). This arched shape of the flow distribution member 82 provides a plenum chamber 262a (recalling the description above) which assists in a uniform distribution of pressurized air to all of the inflatable chambers 254 serviced by the non-return valves 264. The flow distribution member 82 as seen in Figures 7-11, extends
10 radially between the paired flexible sheets 264a/b, but extends only a portion of the way to the outer extent of these sheets so that a radially outer portion of the sheets 264a/b is sealingly engageable with each other within the respective chamber 254 to sealingly prevent back flow of air from the chambers once these chambers are inflated.

Viewing Figures 7-11 it will be understood that where the bonding areas 252c cross the
15 sheets 264a/b, that the walls 252b and sheets 264a/b are respectively bonded together. However, the flow distribution member 82 is formed of a material that does not bond with the walls 252b or with the sheets 264a/b during this thermal bonding process. The result is that the flow distribution member 82 prevents the bonding process from sealingly uniting the sheets 264a/b with one another in the area congruent with the overlying bond area 252c. If these
20 sheets 264a/b were sealingly united in this congruent part of the bond area, then flow from the fitting 256 into the chambers 254 would be blocked. That is, the flow distribution member 82 ensures that the plenum chamber 262a remains open between the fitting 256 and the chambers 254.

Figures 12 and 13 illustrate yet another embodiment of a dunnage apparatus 352. In
25 this case also, the dunnage apparatus 352 is configured to be used in a container that is square or rectangular in plan view (i.e., like the container seen in Figures 1-4). Because the dunnage apparatus 352 has several features and functions in common with the apparatus 52, 152, and 252, these features are indicated on Figures 12 and 13 using the same numeral used above with reference to Figures 1-4, but increased by three-hundred (300). The dunnage apparatus 352
30 also includes plural inflatable chambers 354, which chambers are in flow isolation from one another once inflated, and which sub-divide the plan view of a package to substantially prevent sloshing of the contents of the package, as will be further explained.

Viewing Figures 12 and 13 in conjunction with one another it is seen that the dunnage apparatus 352 has a generally square or rectangular plan-form shape 352a (i.e., generally

matching the plan-form shape of a package like package 40 seen in Figures 1 and 2). As with the embodiments depicted and described earlier, the apparatus 352 is formed of upper and lower generally planar square or rectangular plastic sheets 352b (best seen in Figure 12). The sheets 352b are bonded to one another at bond areas indicated with the arrowed numeral 352c.

5 Consequently, the dunnage apparatus 352 defines plural radially extending inflatable chambers 354 (similarly to the embodiment of Figure 5). These inflatable chambers 354 are shown deflated in Figure 12, which also illustrates that the apparatus before its first use defines preformed separations or separation lines 352d. The separation lines 352d are preferably not formed as complete separations in order to provide ease of handling of the dunnage apparatus
10 preparatory to its being placed into a package for first use. However, the lines 352d may also be a series of aligned comparatively short separations that cooperatively form a weakened tear line which will be effected when subjected to sufficient stress.

As Figure 13 shows, when the apparatus 352 is inflated, the swelling of the inflatable chambers 354 provides sufficient stress on the walls 352b of the apparatus 352, that the
15 apparatus partially separates along the radial lines 352d and takes on an appearance somewhat like a puffy four-leaf clover in plan view. An advantage of the four-leaf clover-shaped embodiment seen in Figures 12 and 13 is that each radially extending "leaf" (i.e., an inflated chamber 354) of the apparatus 352 extends from near the center of the package deeply into an inside corner of the square or rectangular (i.e., in plan view) package in which the apparatus
20 352 is utilized. Understandably, sloshing of the contents of a package is ordinarily most pronounced and is the most powerful as the contents slosh into and out of the corners of a square or rectangular package (recalling the description above of the prior art package seen in Figures 22-24). Thus, it will be understood that the embodiment of Figures 12 and 13 is very effective to substantially prevent this sloshing in square or rectangular packages.

25 Figure 14 illustrates yet another embodiment of a dunnage apparatus 452. In this case the dunnage apparatus 452 is configured to be used in a container that is circular in plan view (i.e., like the container seen in Figures 6-11). Because the dunnage apparatus 452 has several features and functions in common with the apparatus 52, 152, 252, and 352, as discussed above, these features are indicated on Figure 14 using the same numeral used above with
30 reference to Figures 1-4, but increased by four-hundred (400). The dunnage apparatus 452 includes plural inflatable chambers 454, which chambers are in flow isolation from one another once inflated, and which sub-divide the plan view of a package to substantially prevent sloshing of the contents of the package, as is further explained below.

Viewing Figure 14, it is seen that the dunnage apparatus 452 has a generally circular plan-form shape 452a (i.e., generally matching the plan-form shape of a package like package 72 seen in Figure 6). As with the embodiments depicted and described earlier, the apparatus 452 is formed of upper and lower generally planar circular plastic sheets 452b. The sheets 452b are bonded to one another at bond areas indicated with the arrowed numeral 452c. It is to be noted that in this case the bond areas 452c also surround plural windows 452e, and define chambers 454 which are both radially extending and of T-shape in plan view.

Consequently, the dunnage apparatus 452 defines plural radially extending T-shaped inflatable chambers 454 (radially extending similarly to the embodiment of Figure 7), and which are circumferentially extending as well. Because these inflatable chambers 454 extend circumferentially as is shown in Figure 14, when these chambers are inflated they provide a radially outwardly positioned constraint on the contents of a package (i.e., a package having a circular plan form shape) and which constraint on sloshing of the package contents is also circumferentially extending. This arrangement of the chambers 454, which each have a large part of their plan form area disposed at a radially outer extent of the ullage volume is very effective to prevent sloshing of the contents of such a package. Although the chambers 454 are not circumferentially continuous (which they cannot be since they sub-divide the plan form shape of the package in which dunnage apparatus 452 is employed) they are cooperative in providing a nearly continuous circumferentially extending peripheral constraint on the contents of the package. As was pointed out above, since the contents of a package tend to slosh most at the outer extent of the plan form shape of the package, this configuration of the embodiment of Figure 14 (similarly to the embodiment of Figures 12 and 13) is very effective in preventing such sloshing.

Turning now to Figures 15, and 16, another alternative embodiment of a bag-in-box package 90 according to the present invention is illustrated. Similarly to the package 40 seen in Figures 1-4, this package 90 has the form of a crate 92 mounted to a pallet 94. The crate 92 includes a removable lid 92a, which is held in place during storage and shipping of the filled package by bands (indicated by the arrowed reference numeral 92b on Figure 15). The crate 92 of package 90 defines an interior chamber 92c, within which is disposed a plastic bag 96 having a wall 96'. In this case, the bag 96 is not conventional (although it may preferably be of "lay flat" type) and defines both an inner chamber 96a accessed via a fitting 98 with a removable cap 98a, and an outer chamber 96b (i.e., outer in the sense that chamber 96b partially surrounds chamber 96a), accessed by another fitting 100. In the chamber 96a, liquid

or semi-liquid contents 96c may be placed, as will be understood to those ordinarily skilled in the pertinent arts.

The bag 96 is formed by heat sealing walls 96' indicated by the arrowed pressure/heating characters Q/P on Figure 16. Each of the walls 96' includes at least two plies (as is seen in Figure 16) and these walls cooperatively define the chamber 96a. The one wall 96' is provided with opening 96'' opening through at least an outer ply of the one wall, but not opening all the way to the chamber 96a.

The chamber 96b is defined between plies of the wall 96' of the bag 96 at the opening 96''. Further, the fitting 100 is secured, by bonding, for example, to the outer surface of wall 96' at an opening 96'' without heat sealing the inner plies of the bag 96 to one another and to the at least one outer ply of the bag 96 at this location. The fitting 100 includes a flap type of non-return valve member 100a which will disengage from its position of seating engagement with the fitting 100 (as is seen in Figure 16) to allow an inflow indicated by arrow 102 in Figure 16. Consequently, the chamber 96b (which is really a chamber defined within a wall 96' of the bag 96), may be inflated with air.

As is seen in Figure 15, the bag 96 is placed into a crate 92 and it then filled with contents 96c via fitting 98. However, this filled bag 96 does not completely fill the volume of the crate 92 so that an ullage volume (indicated by arrowed numeral 104 on Figure 15) results. In order to control sloshing of the contents 96c that will result from movements of the contents in this ullage volume, the chamber 96b is inflated after securing of the lid 92b. The chamber 96b may be inflated via an opening 106 through the lid 92a at which the fitting 100 is accessible to introduce inflating air flow 102. Thus, the chamber 96b expands as is seen in Figure 15 so that the at least one outer ply of the bag 96 engages the inner surfaces of the crate 92 including the inside of lid 92a. Thus, the at least one outer ply of the bag 96 is isolated from flexing, stressing, and fatigue that may result from sloshing of the contents 96c of the bag 96. Although the inner plies of the bag 96 which inwardly bound the chamber 96b are pressed into contact with the contents 96c and do move with these contents as sloshing occurs, the at least one outer ply of the bag 96 is isolated from this sloshing because it is pressed by the supra-ambient pressure in chamber 96b against the walls and lid of the crate 92. Even should the inner plies of the bag 96 fatigue and fissure or crack at one or more locations, the outer ply of this bag will remain intact and will protect the contents 96c from the ambient.

Further to the above, viewing Figure 15 it will be understood that the opening illustrated in lid 92a by which fitting 98 can be accessed is optional. In other words, the chamber 96a may be filled via fitting 98 while the lid 92a is yet removed from the crate 92,

following which the lid 92a is placed and secured on the crate 92. After the lid 92a is secured, the chamber 96b is filled via fitting 100 and opening 106 by admitting pressurized gas 102, as explained above.

Figure 17 illustrates yet another alternative embodiment of a bag-in-box package 110 according to the present invention. Similarly to the packages 40 and 90, respectively seen in Figures 1-4, and in Figures 17 and 18, this package 110 has the form of a crate 112 mounted to a pallet 114. The crate 112 includes a removable lid 112a, which is held in place during storage and shipping of the filled package by bands (indicated by the arrowed reference numeral 112b on Figure 17). The crate 112 of package 110 defines an interior chamber 112c, within which is disposed a plastic bag 116 having a wall 116' defining an inner chamber 116a. Again in this case, the bag 116 is not conventional, but includes a fitting 118 with a cap 118a. The liquid or semi-liquid contents 116b' of the bag 116 may be introduced and withdrawn from the bag via fitting 118. The bag 116 may be of "lay flat" configuration.

Importantly, the cap 118a includes an inflation feature (indicated by arrowed numeral 118b on Figure 17). The inflation feature 118b allows inflation gas (i.e., pressurized ambient air, pressurized sterilized air, or sterile nitrogen, for example) to be introduced into and released from the chamber 116a. The result is seen in Figure 17 in which the liquid or semi-liquid contents 116b' of the bag 116 are disposed in the lower portion of the chamber 116a, above which is disposed a gas-filled volume 116c of pressurized supra-ambient gas. Because the pressurized gas in the volume 116c presses the wall 116' of the bag 116 against the inner surfaces of the crate 112, including the lid 112a, these walls are effectively isolated from sloshing of the contents 116b of the bag.

It will be noted that with the embodiments seen in Figures 15-17, the inflation gas pressure in chambers 96b and 116a may also assist in suppressing sloshing of the contents of these packages. This may be the case because the inflation gas pressure may assist in "settling" the contents into the package, so that surface wave action of the liquid or semi-liquid contents is less pronounced than it would be if these contents were only under ambient atmospheric pressure.

Figures 18 and 19 depict still another alternative embodiment of the present invention, which has similarities to the embodiment of Figures 6-11. In this instance the dunnage apparatus 122 is also configured for use with a bag-in-container package which is circular in plan form (i.e., taking generally the form of a barrel, for example). The barrel may be formed of metal, fiberboard, or other material. The package will include a removable lid provided with a central opening, similarly to that depicted and described above with reference to Figures

6-11. Within the package/barrel will be held a conventional plastic bag, which may have an appearance the same as the bag seen in Figure 27. Above the filled bag in the package is disposed the dunnage apparatus 122. Because the dunnage apparatus 122 has several features and functions in common with the apparatus 252, these features are indicated on Figures 18 and 19 using the same numeral used above with reference to Figures 1-4, but increased by four-hundred (400). The dunnage apparatus 122 will be seen to include a rigid or shape-retaining arcuate partition member 124 upon which is provided plural (four in this case) inflatable chambers 454. These chambers 454 are in flow isolation from one another once inflated, and sub-divide the ullage volume (i.e., in plan view) of a package having a circular plan view shape so as to substantially prevent sloshing of the contents of the package. The dunnage apparatus 122 substantially prevents sloshing of the contents of the package, as will be further explained.

Viewing Figures 18 and 19 in greater detail, it is seen that the dunnage apparatus 122 has a generally centrally located manifold and valving assembly 462. The valving assembly 462 includes a respective non-return valve (indicated with arrowed reference numeral 464) serving each one of the four inflatable chambers 454. Thus, pressurized air can be communicate simultaneously into the chambers 454 from the assembly 462, but the non-return valves 464 prevent outflow of this pressurized air from the chambers 454 back to the assembly 462.

The manifold and valving assembly 462 includes a central boss 126 defining an upwardly disposed opening 126a, into which the flow 460 of pressurized inflation air may be directed, as was described above with reference to Figures 6-11. Thus, when the dunnage apparatus 122 is disposed in the ullage volume of a filled container, and the apparatus 122 is inflated, the arcuate partition member 124 is forced resiliently downwardly onto the filled bag of the package. Because the apparatus 122 sub-divides the plan form view of the ullage volume into plural chambers which are in fluid back flow isolation from one another, the partition member 124 is held resiliently by the inflation pressure in the chambers 454 in a substantially determined position atop the filled bag and contents of the package. Thus, sloshing of the contents of the package is substantially prevented. It will be noted in considering the embodiment of Figures 18 and 19 that the ullage volume of a package including the dunnage apparatus 122 is effectively eliminated by the apparatus 122 when inflated. That is, the partition member 124 is moved downwardly atop of the filled bag of the package and its contents. Further, because the partition member is resiliently held in place by

the inflated chambers 454, the partition member 124 can not move freely and sloshing of the contents of the package is substantially prevented.

Figures 20 and 21 illustrate a bag-in-box package 130, which has both some similarities and a number of distinctions both with respect to the conventional package seen in Figures 28-30, and with respect to the embodiments of the invention seen in Figures 1-4, and 5. This embodiment of Figures 20 and 21 also has some elements that are similar to those of the embodiment of Figures 18 and 19. That is, similarly to the embodiment of Figures 18 and 19, the embodiment of Figures 20 and 21 employs a partition member that is urged or biased onto the top of a filled bag of liquid or semi-liquid contents in the package. On the other hand, an inflatable chamber or bladder is not employed in this embodiment of Figures 20 and 21 to effect the biasing of the partition member. On the other hand again, and similarly to the conventional package of Figures 28-30, the package 130 of Figures 20 and 21 includes a lid held in place by bands. But, in contrast to the conventional package, the lid of the package 130 seen in Figures 20 and 21 cooperates with the crate of the package to define a variable-volume chamber in which the bag of the package is received substantially without ullage volume. In other words, the package 130 provides a variable-volume chamber that is variable to exactly match the volume of the filled bag of product in this chamber, and has the result of eliminating the ullage volume substantially entirely.

Turning now to Figures 20 and 21, it is seen that the package 130 outwardly has the form of a crate 132 mounted to a pallet 134. The crate 132 includes a removable lid/partition 132a, which is held in place during storage and shipping of the filled package by bands 132b. It will be noted in Figure 20 that in contrast to the conventional package of Figure 22, the lid 132a does not rest upon the upper edges of the crate 132, but instead is sized and configured to fit within the side walls 132c of this crate 132. Thus, as is best seen in Figure 21, the crate 132 and lid 132a together define an interior variable-volume chamber 132d. Within the chamber 132d is disposed a plastic bag 136, which may be a conventional bag for this type of container (i.e., a bag just like that used in the conventional package of Figures 28-30). The bag 136 may be conventionally filled with, for example, liquid or semi-liquid product 136c (such as a food product, or a non-food product) to be shipped or stored in the package 130. Again, when so filled, the bag 136 becomes generally conformal to the inside shape of the crate 132, but does not completely fill this crate completely to the top of the side walls 132c. Thus, the contents of the bag 136 could slosh about during shipping and handling of the package 130 were it not for the cooperation of the lid 132a with the remainder of the crate to form the variable-volume chamber 132d. It will be noted that the side walls 132c of the crate 132 each define at least

one vertically extending slot (plural slots as illustrated) 132e for receiving the bands 132b. Further, the lid/partition 132a is sized to slip into the crate within the side walls 132c and to rest atop of the filled bag 136 and has spacer features 132s' upon which the bands 132b bear to urge the lid 132a into the crate 132. Thus, the crate 132 and lid/partition 132a cooperatively
5 define a variable-volume chamber 132d, which is contracted as bands 132b are drawn tight to substantially match the volume of the filled bag 136. The lid/partition 132a is held in place by the bands 132b, and it follows that sloshing of the contents of the package 130 is substantially prevented.

Considering now Figures 22-24, a package is illustrated that has some similarities to
10 the embodiment of Figures 6-11. For this reason, features of the embodiment illustrated in Figures 22-24 which are the same as, or which are analogous in structure or function to, features seen in Figures 6-11 are referenced on Figures 22-24 using the same numeral used above, and increased by five-hundred (500). Figures 22-24 illustrate another embodiment of a package 572 according to the present invention. In this instance the apparatus is configured for
15 use with a bag-in-container package taking the form of a barrel. Again, the barrel may be formed of metal, as illustrated (i.e., a typical 55 gallon steel drum), or may be formed, for example, of fiberboard or plastic. The package 572 includes a removable lid 574, which is held to the body of the barrel by a clamp band 574a. The lid 574 is in this embodiment not provided with a central opening (as was indicated with the numeral 74c in Figure 6. The lid
20 574 in this case does include an offset or generally peripheral inflation opening 574c', the purpose and function of which will be further explained below. Within the barrel 572 is held a plastic bag 576. This bag 576 will have an appearance as is seen in Figure 24, which is considerably different than the bag seen in Figure 32. While it is seen in Figure 23 that the package 572 has a circular shape in plan view, it is seen in Figure 24 that the bag 576 is
25 substantially flat. This bag 576 is formed of a pair of flat walls 576a and 576b, which are cooperatively bonded sealingly together at a peripheral seam 576c. An additional line of bonding at 576d divides the bag 576 into a first chamber 576e, and a second chamber 576f. A fitting 578a is secured into the seam 576c at the top of the bag 576 and gives access to the chamber 576e. Similarly, another fitting 578b is secured also into the seam 576c at the top of
30 the bag, and gives access to chamber 576f. Thus, as is seen in Figure 22, after the chamber 576e is filled with a selected volume of contents, the fitting 578a is closed and the lid 574 is secured onto the barrel 572. The fitting 578b is introduced into the opening 574c of the lid 574 as this lid is placed on the barrel 572, so that it protrudes outwardly through the opening 574c, as is seen in Figure 22. Thus, it will be understood that the fitting 578b is employed to fill the

chamber 576f with a sufficient volume of pressurized fluid (i.e., pressurized air, gas, or liquid, for example) that the ullage of the package 572 is entirely held in the chamber 578f, viewing Figure 22 again.

5 With the package as seen in Figures 22-24, sloshing of the liquid or semi-liquid contents in chamber 576e of the bag 576 is substantially prevented because these contents are forced against the walls of the barrel, as is seen in Figure 22.

10 Finally, turning now to Figures 25-27, another alternative embodiment of the invention is illustrated. The package of Figures 25-27 has features in common with that embodiment of Figures 1-4, except that the embodiment of Figures 25-27 will be seen to be self-inflating, as will be explained. Again, because the reader will by now be familiar with the features of Figures 1-4, the same reference numeral used above is increased by six hundred (600) and is employed on Figures 25-27 to indicate the same features or features that are analogous in structure or function.

15 The package 640 has the form of a crate 642, which may be mounted on a pallet (not seen in Figures 25-27). The crate 642 includes a removable lid, which is also not seen in Figures 25-27. But, in view of the description above, while it will be understood that a lid just like lid 42a of Figures 1-4 may be utilized on package 640, more preferably a lid is used which is imperforate, and which does not need to include an inflation opening 58 as was required by the embodiment of Figures 1-4. The lid of package 640 is held in place during storage and
20 shipping of the filled package by bands as seen in Figure 1.

The crate 642 defines an interior chamber 642c, within which is disposed a plastic bag indicated by arrowed numeral 646. The plastic bag 646 in this case also may be conventional, with a fitting 646a, and walls 646' to define an internal chamber 646c. Again, an ullage volume 648 is defined within the crate 642 above the filled bag 646. The 640 also includes a
25 dunnage apparatus 652 with many features in common with the dunnage apparatus 52, but which is self-inflating. That is, at the location occupied by the inflation fitting 56 of the embodiment of Figures 1-4, the embodiment of Figures 25-27 includes a gas-generator apparatus 140. As is seen in Figures 26 and 27, the gas generator apparatus 140 includes a vertically extending tubular housing 142 communicating at its lower end to the manifold 662
30 of the dunnage apparatus 652. At its upper end, the tubular housing 142 is closed by a removable cap 142a, as is seen in Figure 27. Within the tubular housing 142, a gas generator cup 144 is suspended by a set of four radially extending struts 146 (only three of which are seen in Figure 26).

As will be understood in view of Figures 26 and 27, after the bag 646 is filled and closed, the dunnage apparatus 652 is placed into the crate atop of this filled bag, as is seen in Figure 25. Then, as is seen in Figure 26, the gas generator apparatus 140 is opened by removal of cap 142a, and an initiating liquid is poured into the gas generator cup 144, as is indicated in
5 Figure 26 with arrowed reference numeral 148. Within the gas generator cup 144 is a mass 150 of a chemical that reacts with the initiating liquid 148 to produce a volume of gas. As is indicated in Figure 27, immediately after introduction of the initiating liquid 148, the cap 142a is placed on the tubular housing 142 so that the gas generated in cup 144 is communicated to manifold 662, as is indicated by arrows 144a.

10 Recalling the explanation above about the dunnage apparatus 52 seen in these Figures, it will be understood that the chambers of the dunnage apparatus 652 are inflated with pressurized gas produced at gas generator apparatus 140. It is to be noted that with the embodiment seen in Figures 25-27, the lid of the crate need not have an opening in it (other than a vent opening perhaps, and then only if the lid fits very tightly to the crate). Ordinarily,
15 the crate and lid will not be air tight, and will allow air to be vented from the ullage volume at an adequate rate as this volume is filled by the expanding dunnage control apparatus 652. This absence of an opening in the lid of the crate provides extra security for the contents of the package.

While the present invention has been depicted, described, and is defined by the
20 following claims by reference to particularly preferred exemplary embodiments of the invention, such reference does not imply a limitation on the invention, and no such limitation is to be inferred. The invention is intended to be limited only by the spirit and scope of the appended Claims giving cognizance to equivalents in all respects.

We Claim:

1. A dunnage volume elimination package for receiving and containing movable contents, and for substantially preventing movement of the contents, the package comprising:

a shape-retaining first package element defining a respective variable-volume first chamber, said first chamber having a maximum volume value;

a flexible second package element disposed within the first chamber and defining a respective second chamber of variable-volume, the second package element defining an inlet opening to said second chamber for receiving the contents of the package;

the second package element when filled at said second chamber with a selected volume of contents cooperating with the first package element to define an ullage volume by which the contents and second package element together fall short of completely filling said maximum volume value;

said first package element including a movable shape-retaining wall member moveable between a first position at which said first chamber has said maximum volume value, and a second position, movement of said wall member from said first position toward said second position varying the volume of said first chamber between said maximum volume value and a lesser volume; and

means for controllably moving said wall member from said first position to a second position to reduce the volume of said first chamber so that said ullage volume is reduced toward a volume of substantially zero.

2. The dunnage volume elimination package of Claim 1 wherein said first package element includes a crate having a base and plural side walls extending upwardly from said base, said side walls together cooperating at respective upper end edges thereof to define an opening to said first chamber, said shape-retaining wall member including said crate including a lid member receivable through said opening and movable relative to said side walls of said crate between said first position in which said lid is received within said side walls and is positioned immediately adjacent to said opening, and said second position in which said lid is received within said side walls and is spaced inwardly of said crate from said opening.

3. The dunnage volume elimination package of Claim 2 wherein said means for controllably moving said wall member from said first position toward said second position includes a spacer feature disposed atop said lid and engageable with packaging bands encompassing said crate to hold said lid in engagement with said second package element.

4. The dunnage volume elimination package of Claim 3 wherein said crate includes plural slots extending along said side walls downwardly from said opening, said slots receiving said packaging bands.

5. The dunnage volume elimination package of Claim 1 wherein said first package element includes a drum, said drum having a base and a side wall extending upwardly from said base, said side wall having an upper end edge at which said side wall defines an opening to said first chamber, said drum including a lid member receivable upon said side wall to substantially close said opening, said lid carrying said movable wall member.

6. The dunnage volume elimination package of Claim 5 wherein said lid carries said wall member, and an inflatable chamber disposed between said lid and said wall member so that inflation of said inflatable chamber moves said wall member away from said lid and reduces said ullage volume toward zero.

7. The dunnage volume elimination package of Claim 6 wherein said drum is of generally circular shape in plan view, and said inflatable chamber includes plural sub-chambers which are cooperatively also generally circular in plan view, and said inflatable chamber also includes a generally centrally located inflation fluid inlet.

8. The dunnage volume elimination package of Claim 7 wherein said plural sub-chambers cooperatively provide a radially extending circular array of plural generally segmental inflatable chambers.

9. The dunnage volume elimination package of Claim 7 further including means for inflating said plural sub-chambers simultaneously

10. The dunnage volume elimination package of Claim 9 wherein said means for inflating said plural sub-chambers simultaneously includes an inflation fluid inlet, a radially disposed manifold arranged to receive pressurized inflation fluid from said inlet, said radially disposed manifold further communicating with said plural sub-chambers individually and simultaneously, and non-return valve means respectively disposed to communicate pressurized inflation fluid radially outwardly in fluid flow communication between said manifold and each of said plural sub-chambers.

11. The dunnage volume elimination package of Claim 10 wherein said plural sub-chambers are individually segment-shaped, and cooperate to sub-divide said circular plan view shape.

12. A variable-volume package for receiving and containing a variable volume of moveable contents, and for substantially preventing movement of these contents during movement and acceleration of the package, the package comprising:

a shape-retaining first package element defining a respective substantially closable first chamber having a variable-volume;

a flexible second package element disposed within the first chamber and defining a respective second chamber of variable-volume, the second package element defining an inlet opening to said variable-volume second chamber, said second chamber receiving said contents via said inlet;

the second package element when filled at said second chamber with a selected volume of contents cooperating with the first package element to define an ullage volume by which the contents and second package element together fall short of completely filling the first chamber; and

said first package element having a movable wall member, which is movable in said first chamber to engage against said second package element.

13. The package of Claim 12 wherein said first package element includes a crate with an opening and a lid, said lid including said wall member and in a first position being received into and substantially closing said first chamber, said lid being movable to a second position also within said first chamber and in which said first chamber has a lesser volume, and means for engaging said lid and urging the lid toward said second position to engage said lid against said second package element.

14. The package of Claim 12 wherein said second package element is formed as a plastic bag.

15. The package of Claim 12 wherein said first package element includes a drum, said drum having a base and a side wall defining an opening to said first variable-volume chamber, and a lid member receivable upon said side wall at said opening to substantially close said first chamber, said lid carrying said movable wall member.

16. The package of Claim 15 wherein said lid carries said wall member, and said lid also carrying an expansible member disposed between said lid and said wall member so that said wall member moves into said first chamber and away from said lid toward engagement with said second package element in response to expansion of said expansible member.

17. A method of substantially reducing toward a zero volume an ullage volume defined within a shape-retaining package so as to substantially prevent movement of moveable contents of the package, said shape-retaining package being adapted for receiving and containing a flexible container holding said contents, and which contents are capable of movements within any ullage volume defined within the package, said method comprising steps of:

employing the shape-retaining package to define a variable-volume first chamber;

utilizing the flexible container to define a variable-volume second chamber within said first chamber, the volume of said second chamber varying in dependence upon the selected volume of contents placed into said flexible container;

employing the flexible container and a selected volume of contents to cooperate with the shape-retaining package to define an ullage volume by which the selected volume of contents and flexible container together fall short of completely filling the first chamber; and

providing a movable wall member which is movable relative to said shape-retaining package to engage against the flexible container and contents so as to prevent movement of the contents.

18. The method of Claim 17 further including the step of utilizing a pressurized gas to move said movable member into engagement with said flexible container.

19. The method of Claim 17 further including the step of providing said pressurized gas as an inflation fluid within an inflatable chamber.

20. The method of Claim 17 further including the steps of forming said shape retaining package in the form of a crate with a base, a plurality of side walls extending from said base upwardly toward an upper edge of the side walls at which these side walls cooperatively define an opening for the crate, and a lid cooperable with the side walls to substantially close said opening.

21. The method of Claim 20 further including the steps of providing said plural side walls with a selected number of slots extending from said opening toward and stopping short of said base, said lid being receivable through said opening to define said movable wall member and to engage upon said flexible container, and said slots receiving packaging bands engaging said lid to urge said lid into engagement with said flexible container and the contents therein.

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FIG. 1.

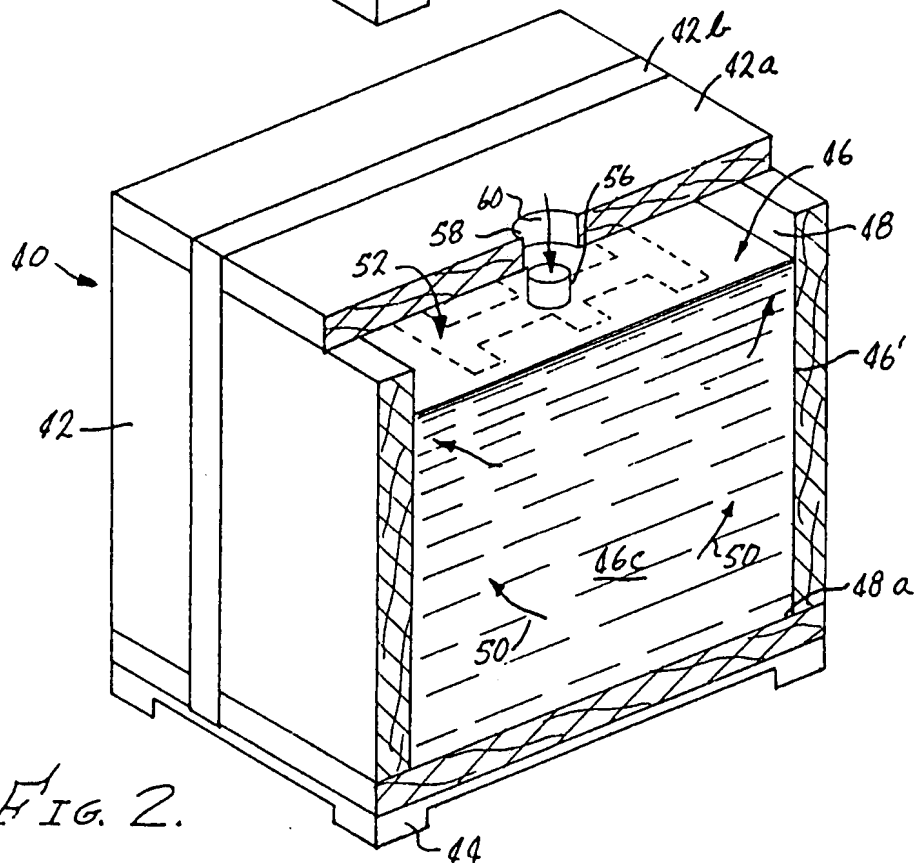
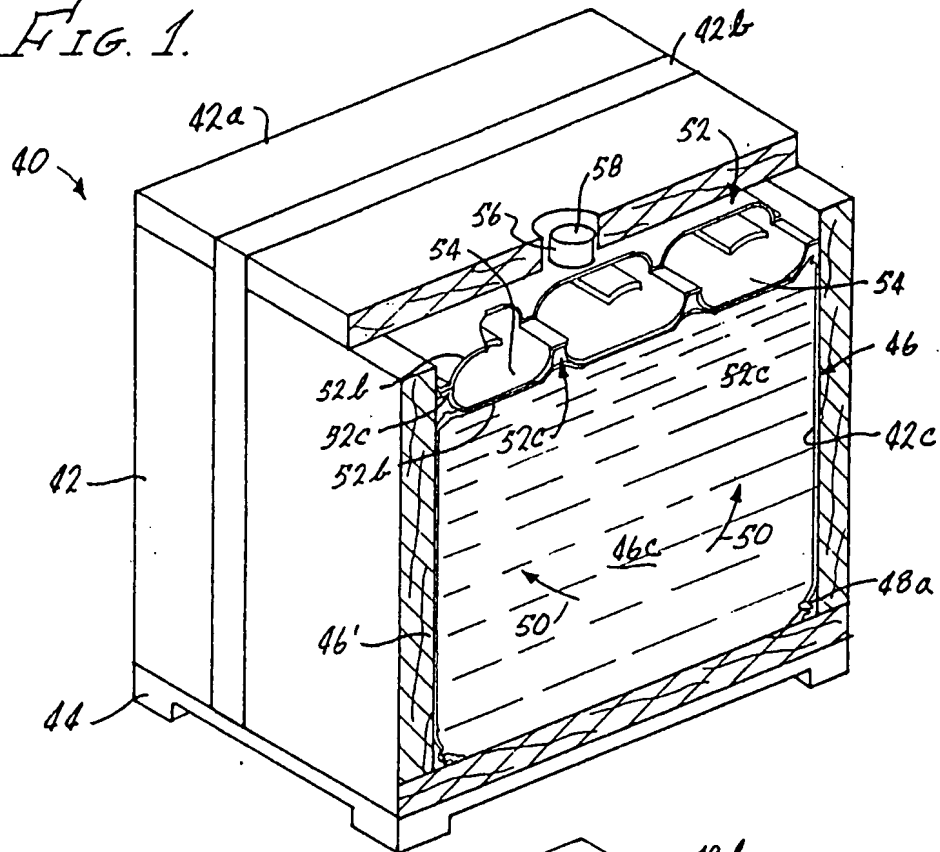


FIG. 2.

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FIG. 3.

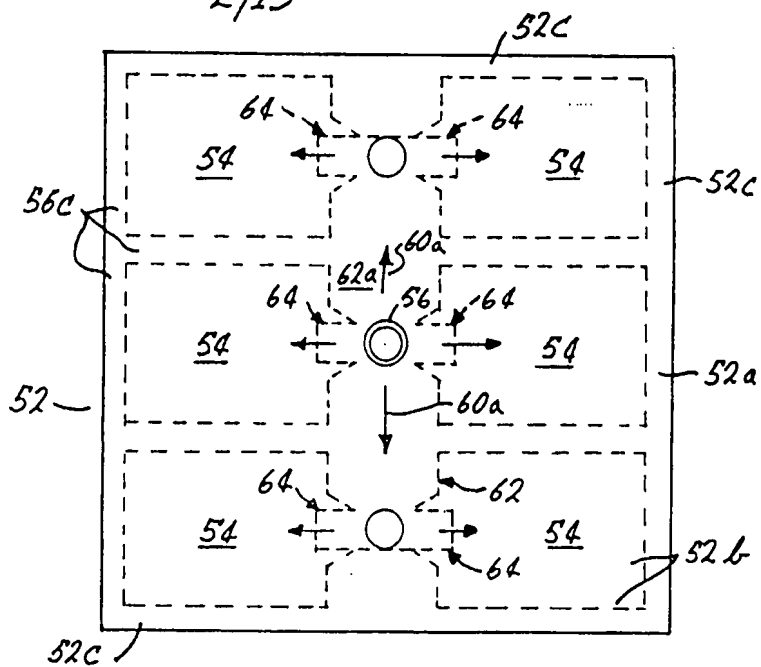


FIG. 4.

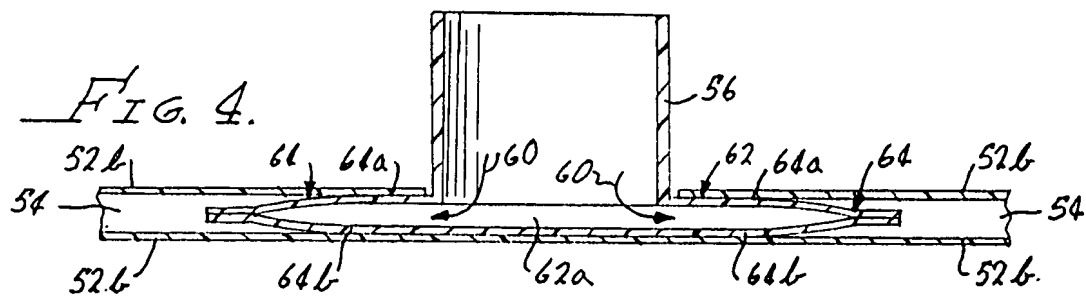
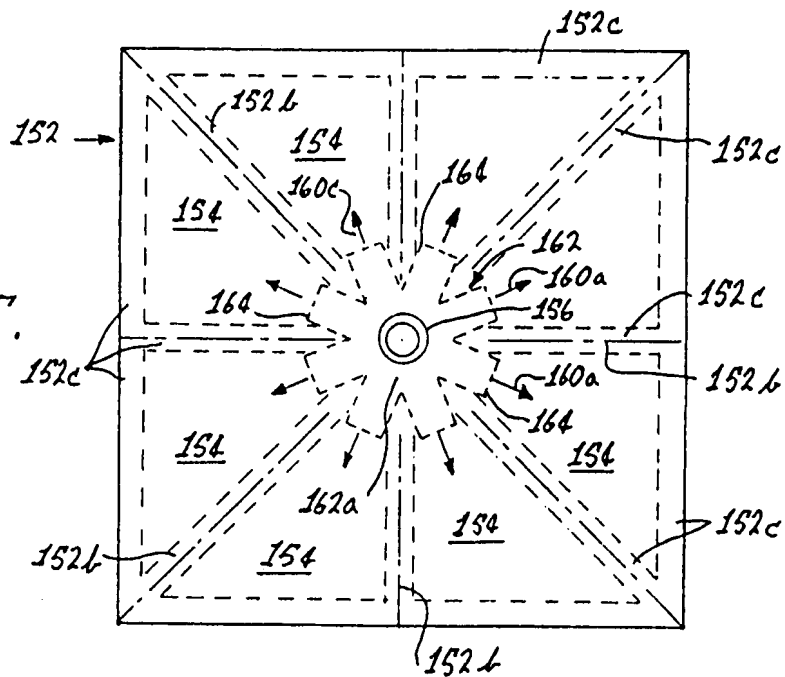


FIG. 5.



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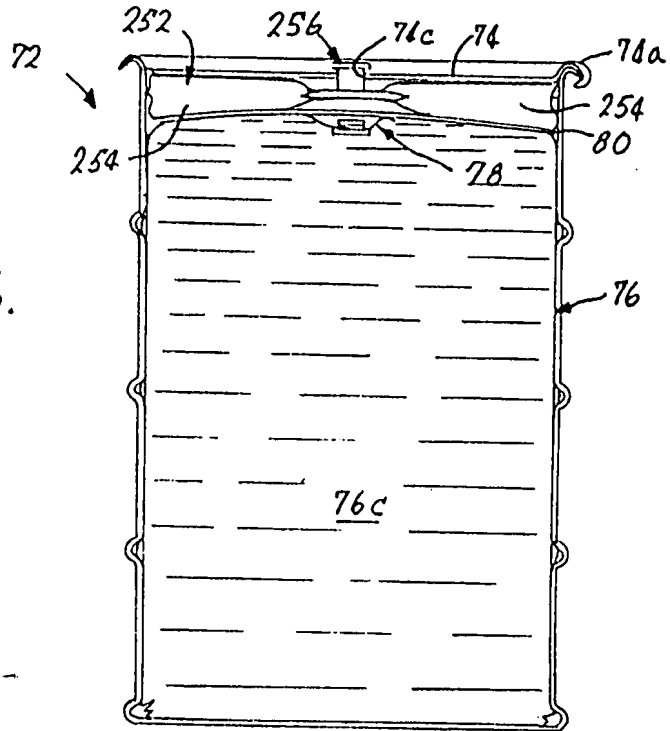


FIG. 6.

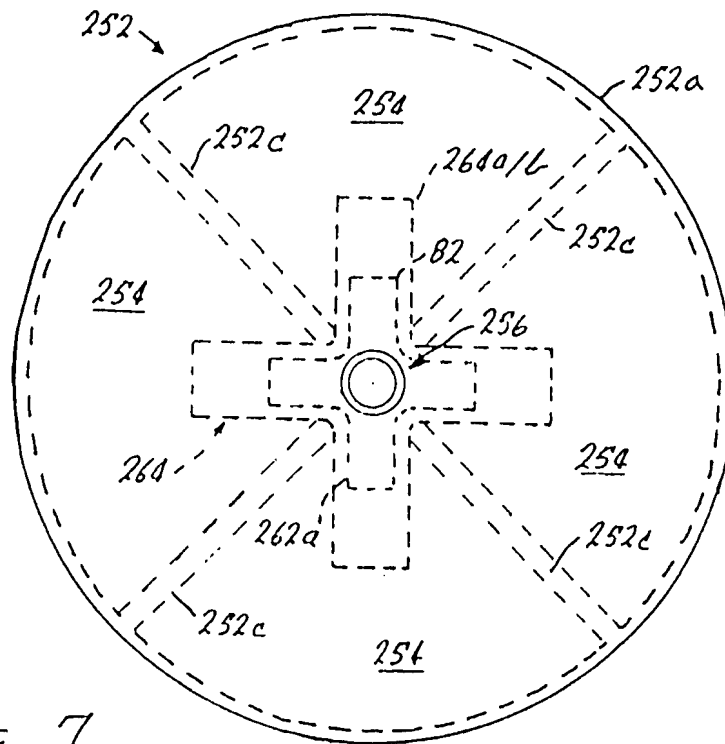


FIG. 7.

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FIG. 8.

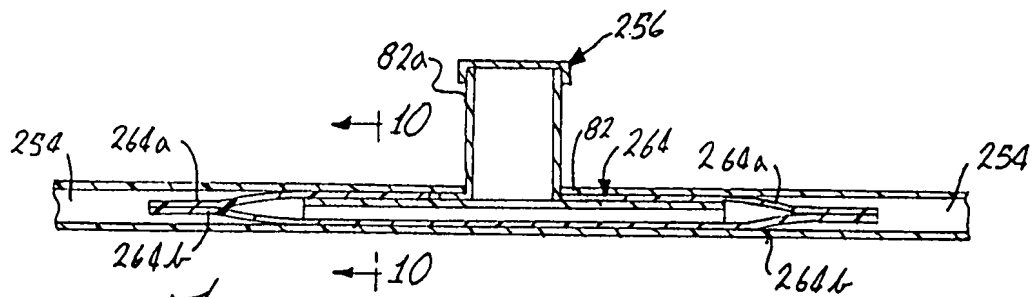
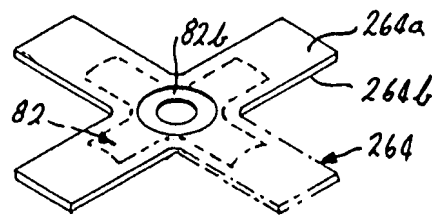
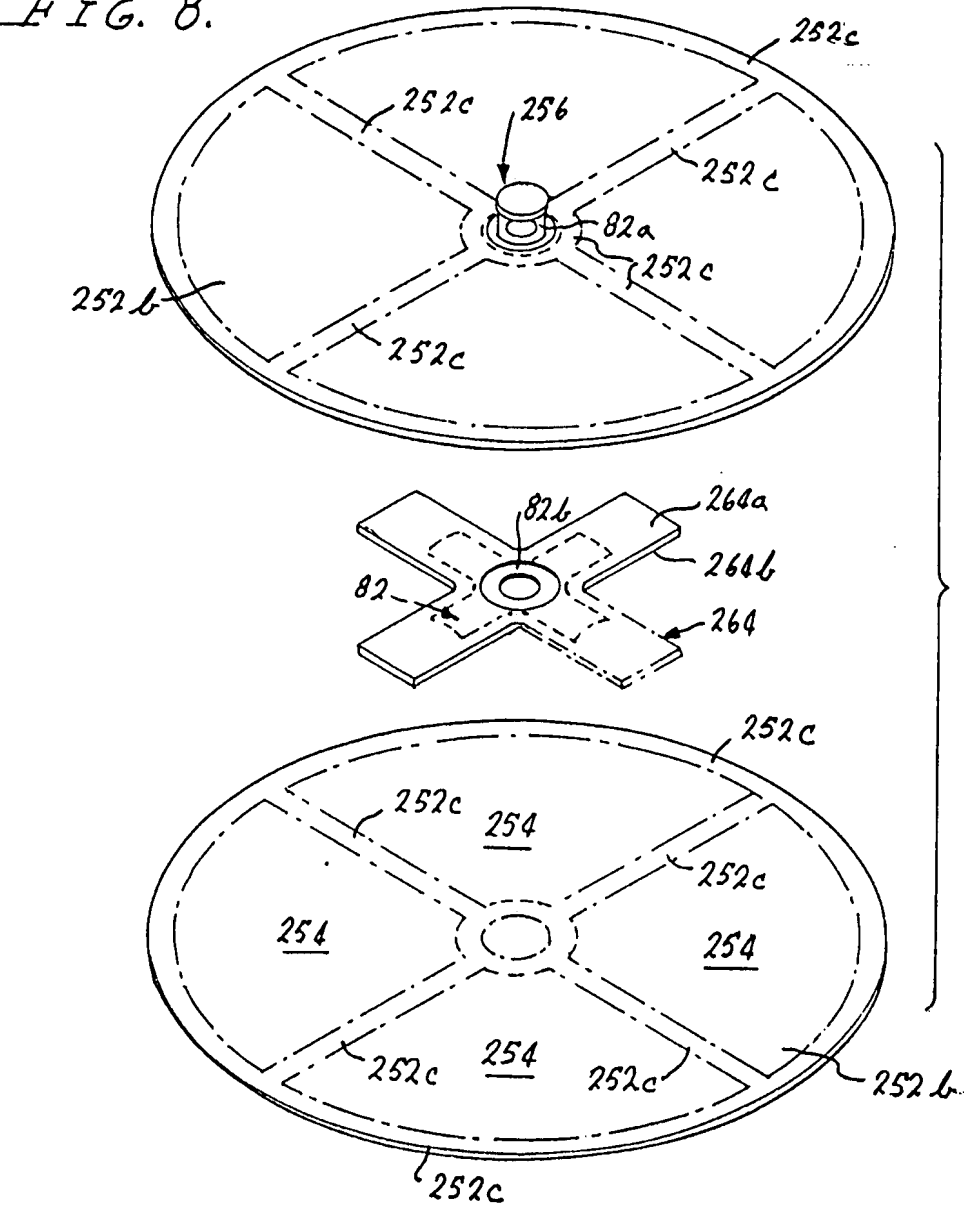


FIG. 9.

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FIG. 10.

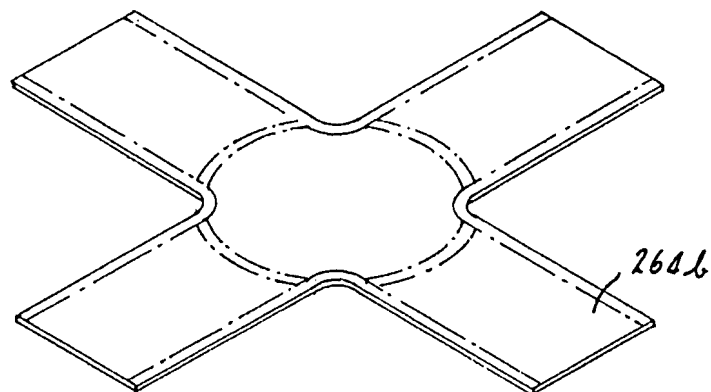
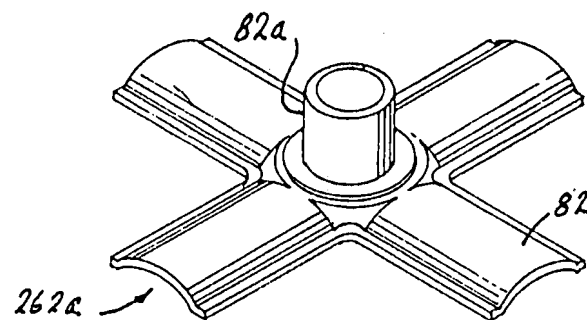
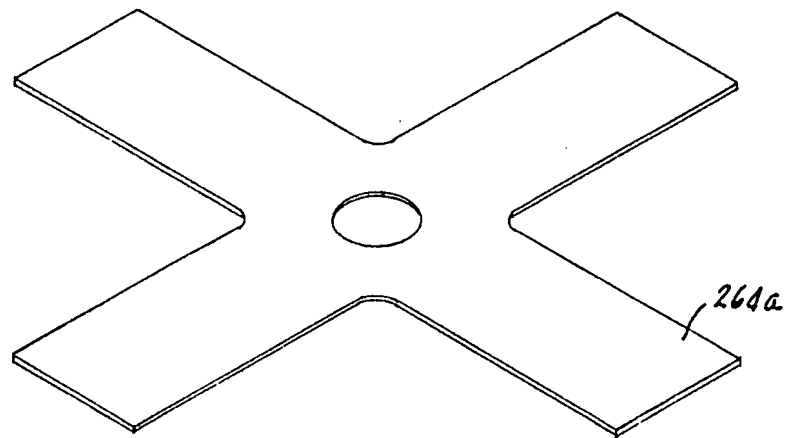
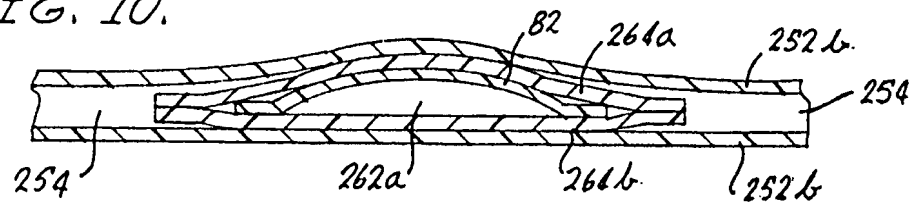


FIG. 11.

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FIG. 12.

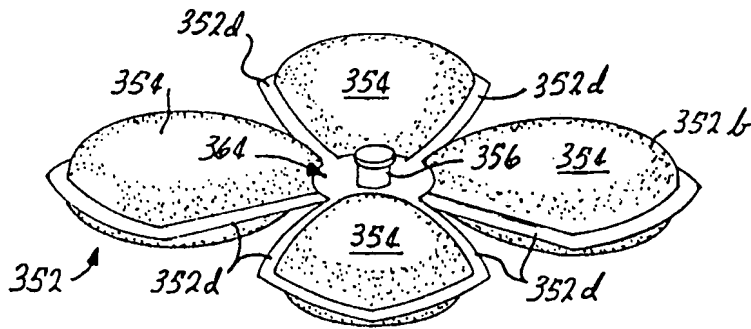
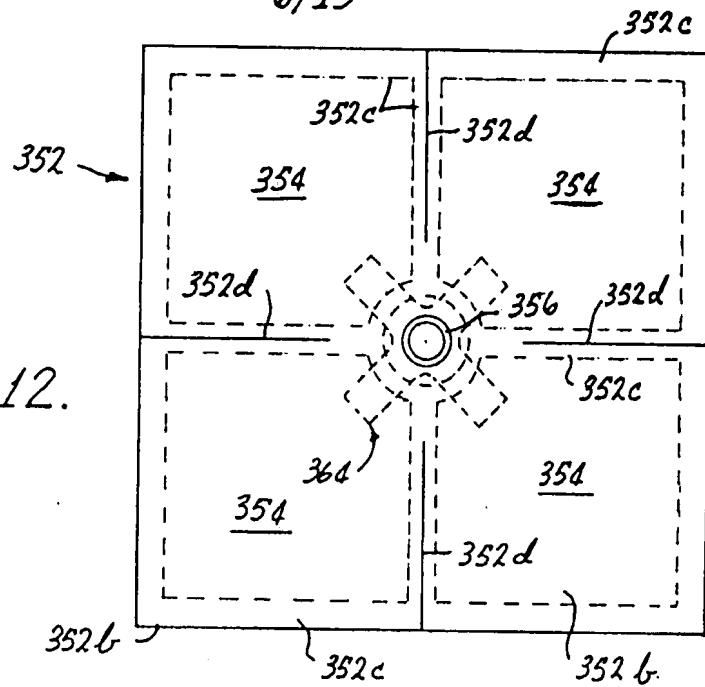
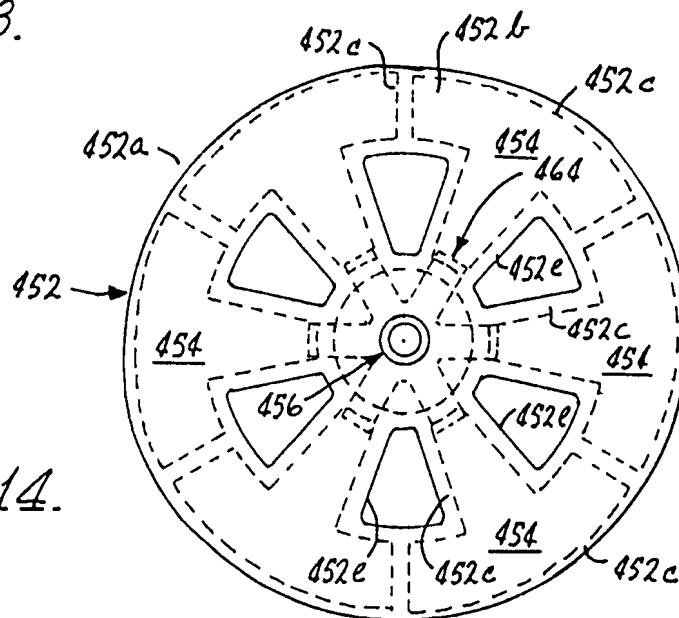
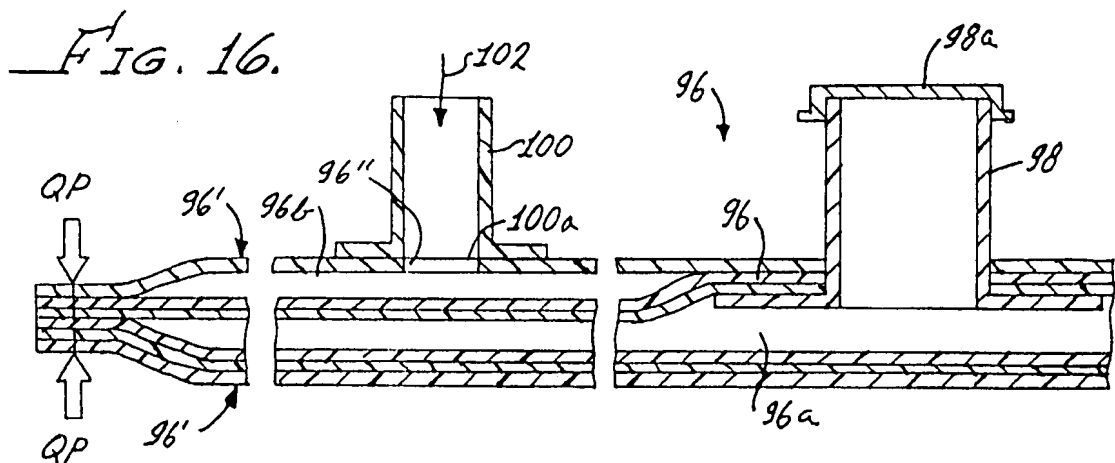
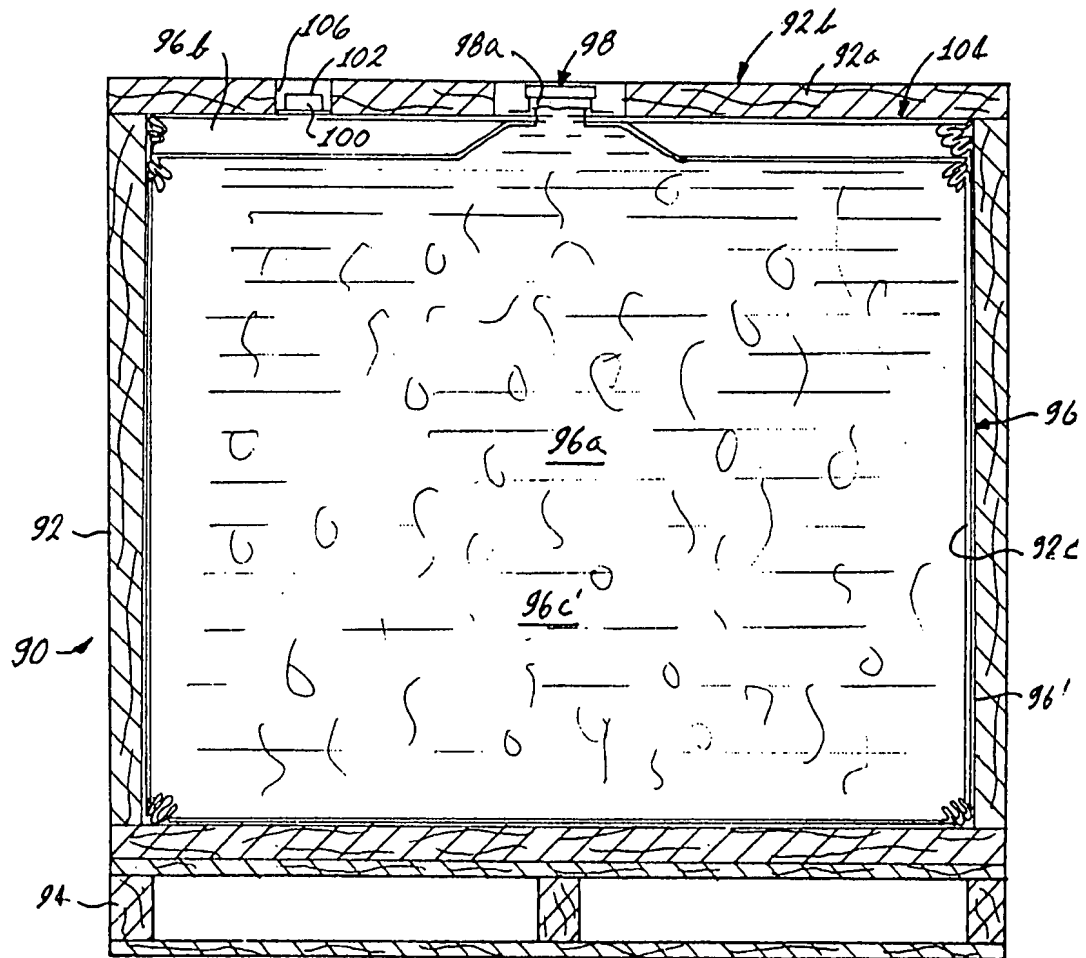


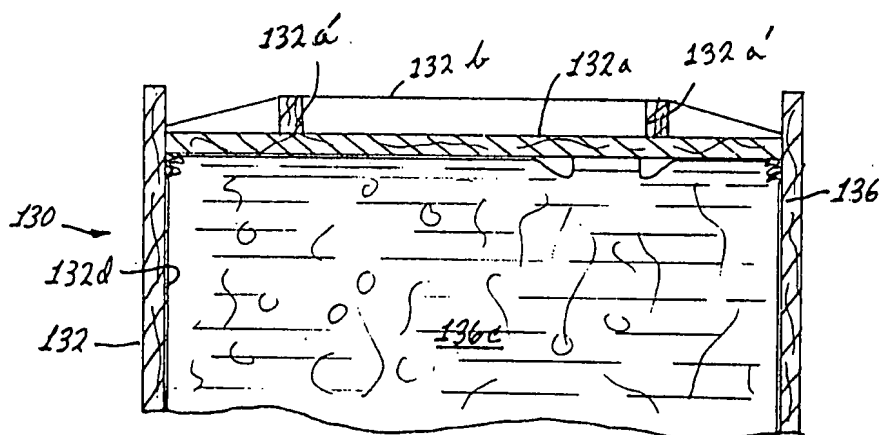
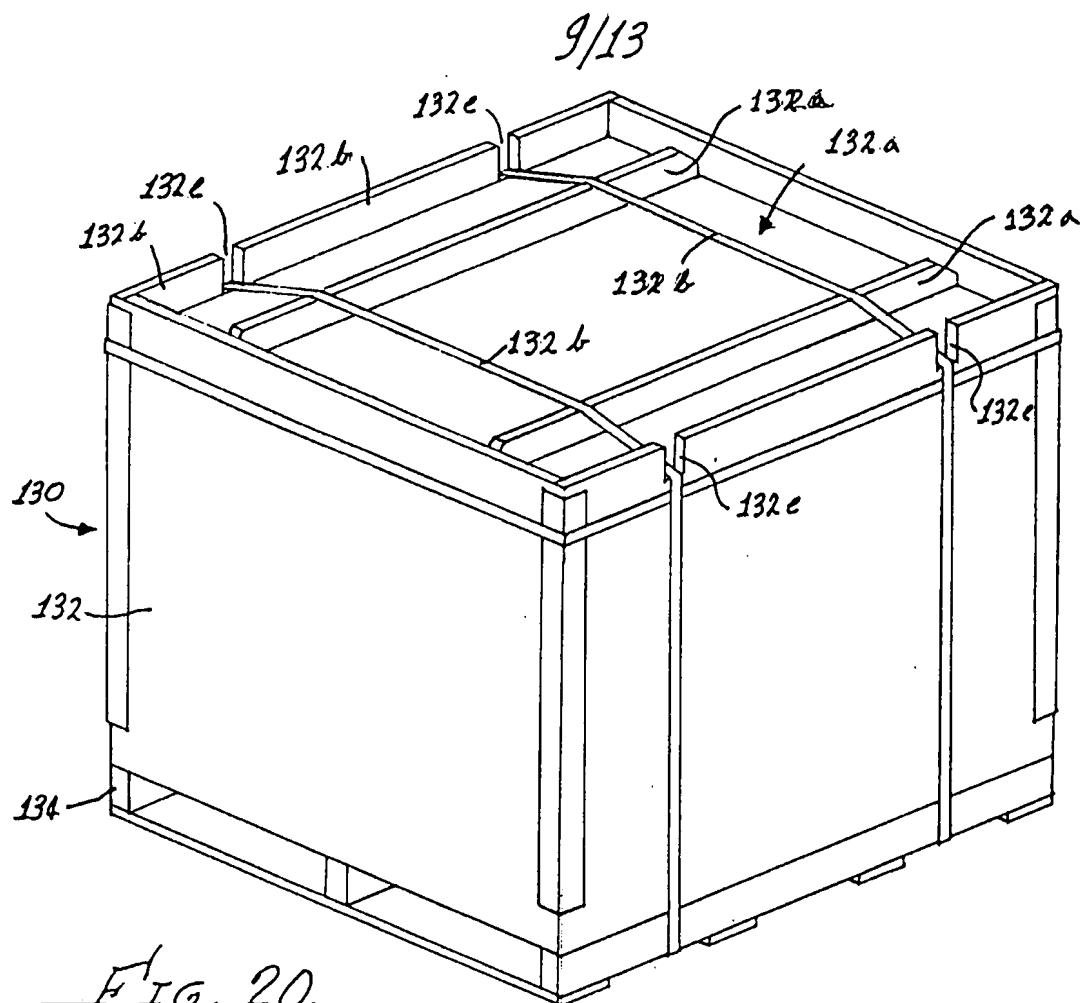
FIG. 13.

FIG. 14.



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FIG. 22.

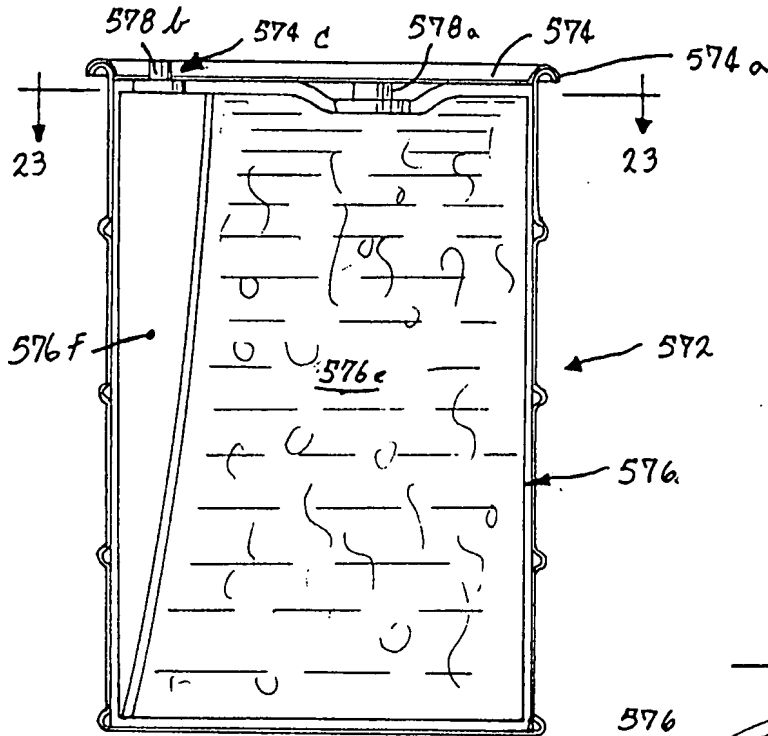


FIG. 23.

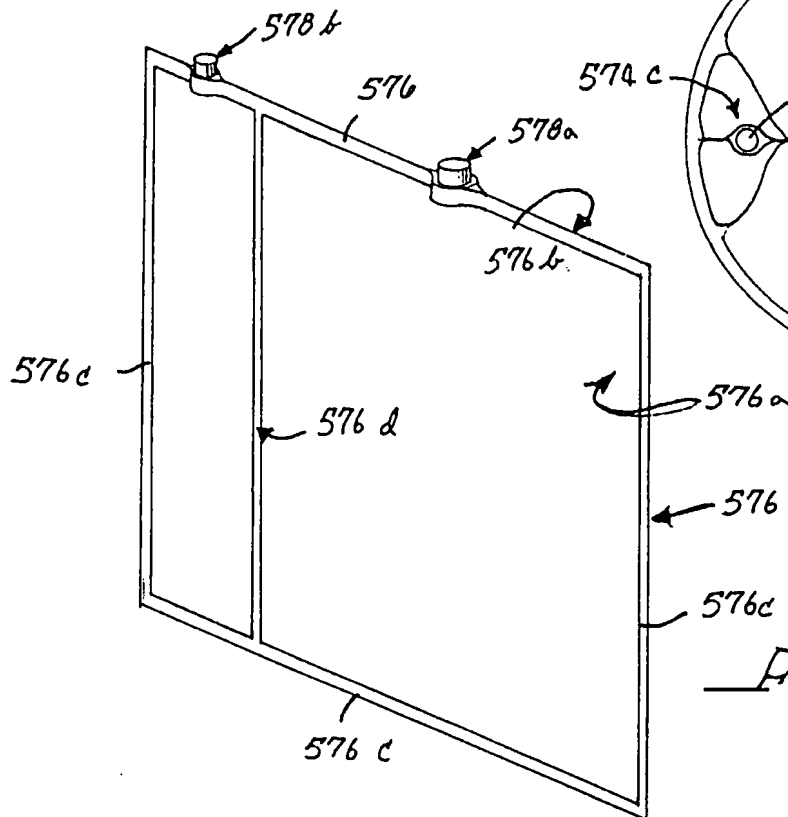
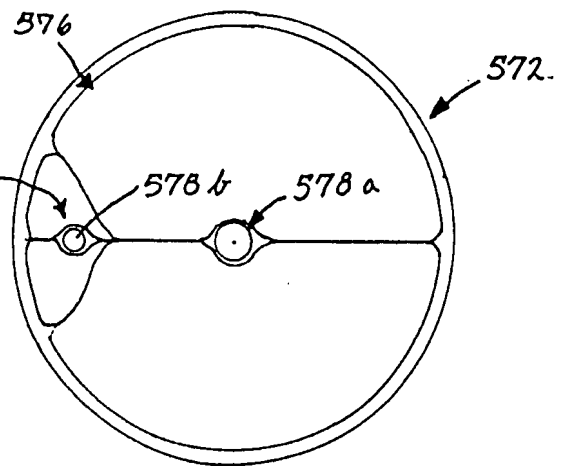


FIG. 24.

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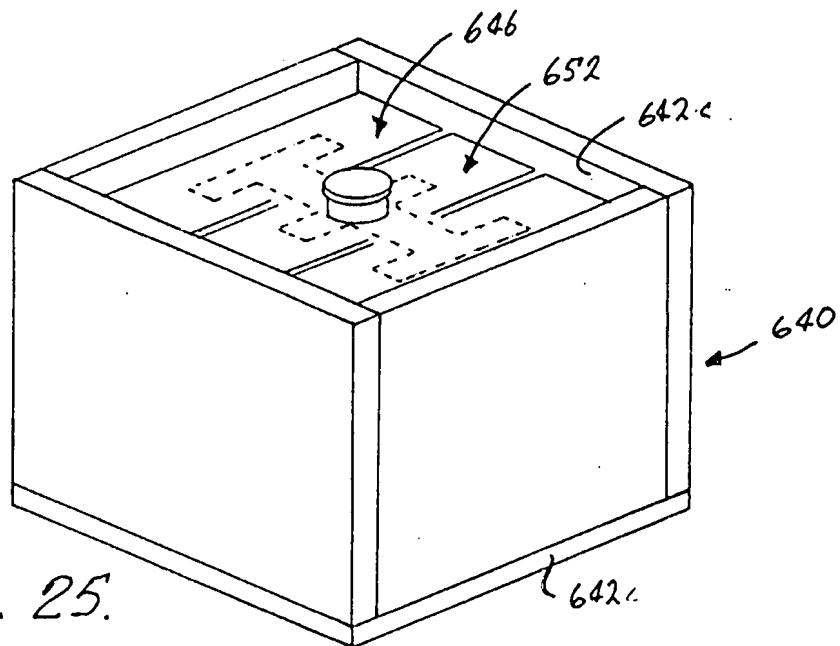


FIG. 25.

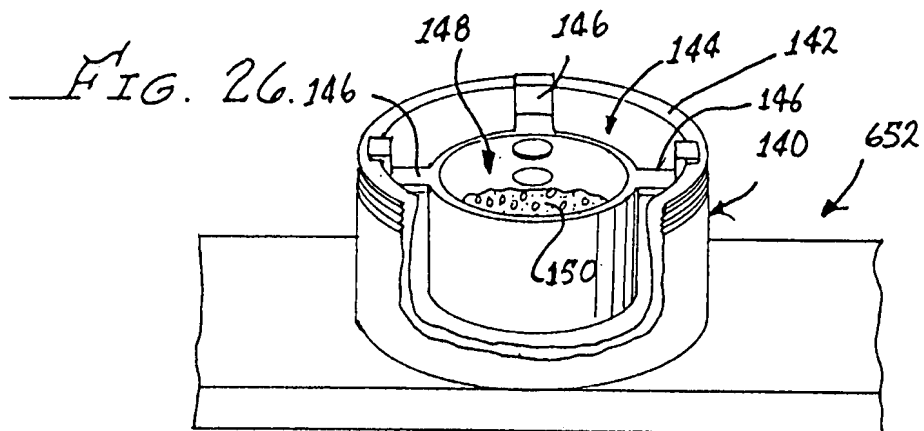


FIG. 26.

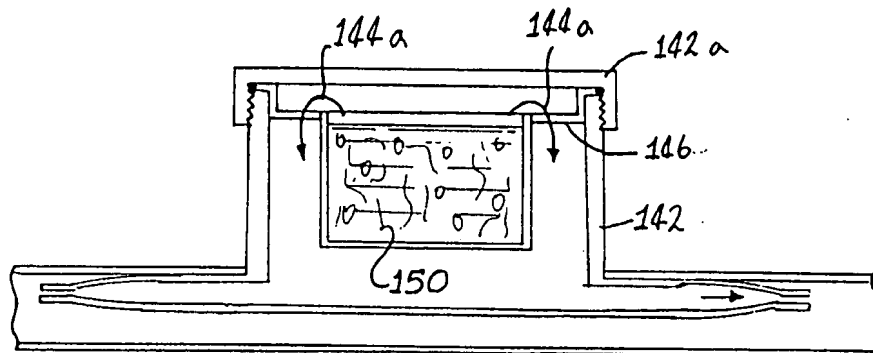


FIG. 27.

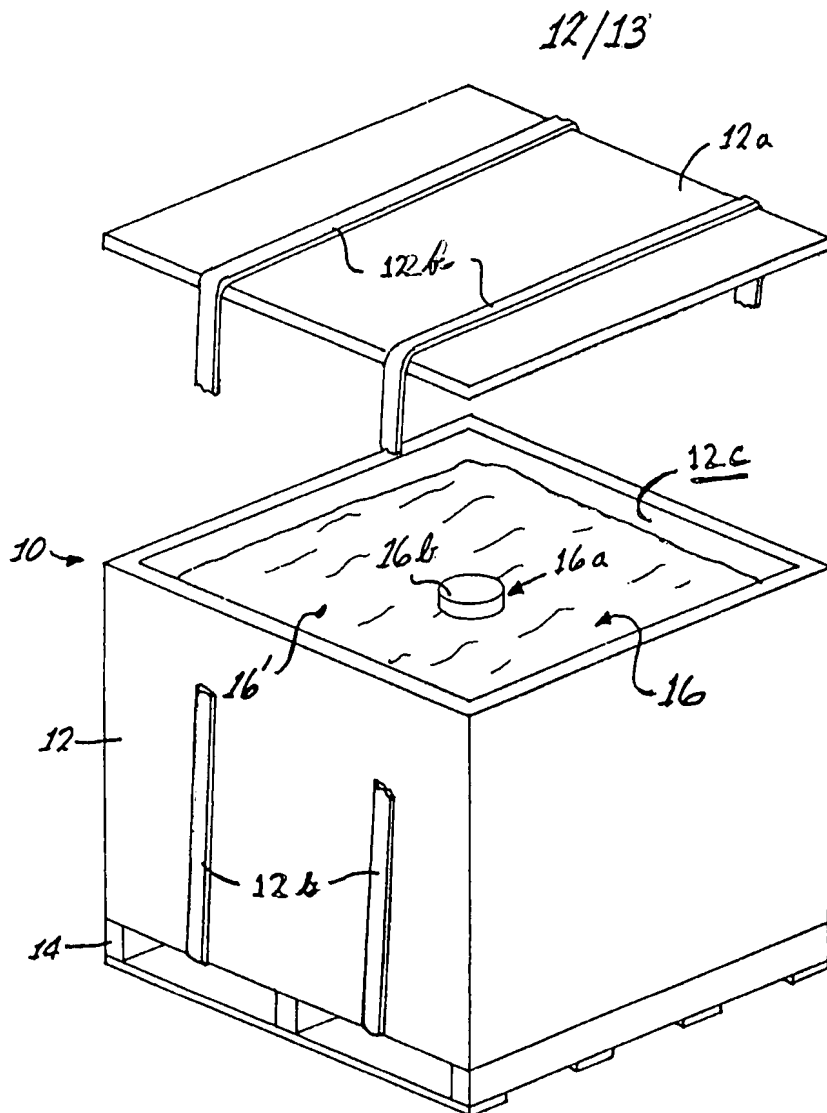


FIG. 28.
(PRIOR ART)

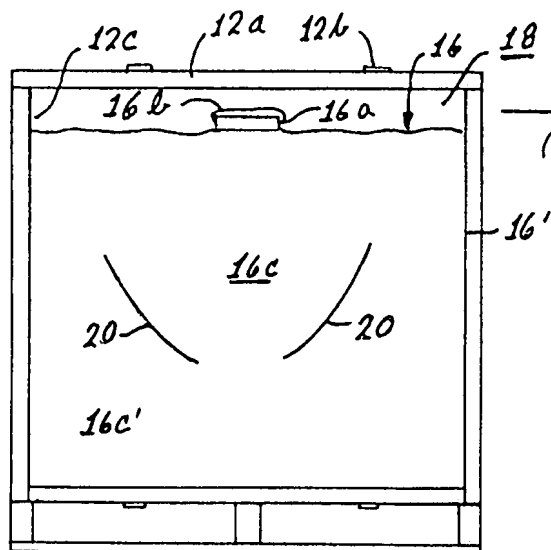


FIG. 29.
(PRIOR ART)

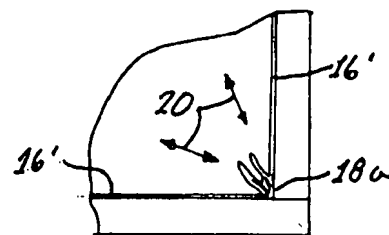


FIG. 30.
(PRIOR ART)

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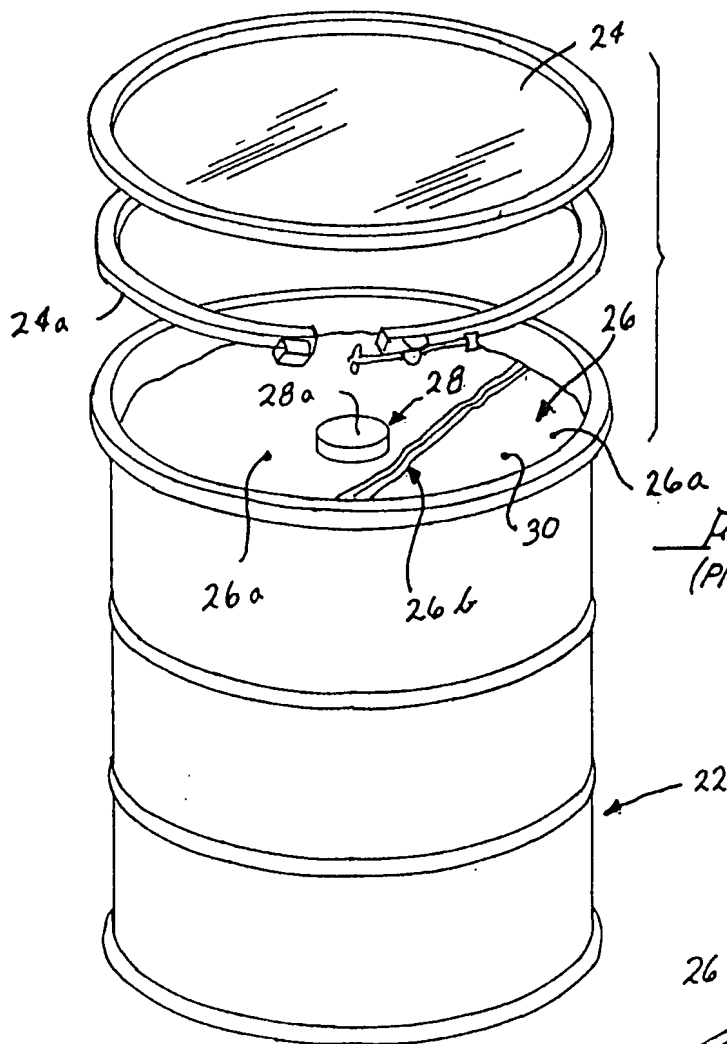


FIG. 31.
(PRIOR ART)

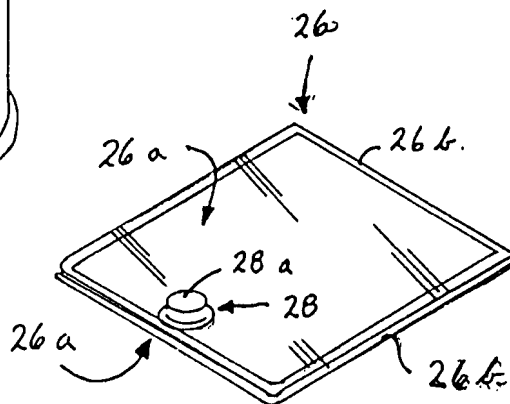


FIG. 32.
(PRIOR ART)

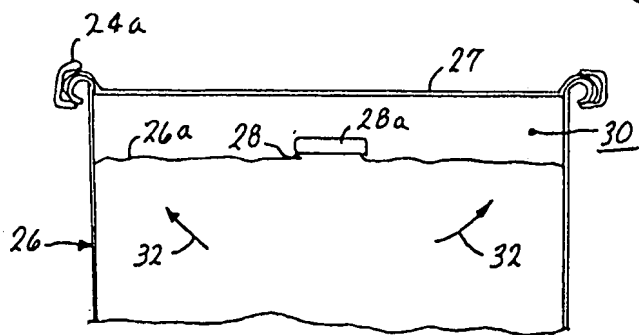


FIG. 33.
(PRIOR ART)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/21873

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B65D 25/00

US CL :220/723

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 220/723, 720; 206/522, 383/3, 38, 44

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2,861,714 A (GLOSSOP) 25 November 1958, Figs. 1-8	1, 5, 12, 14, 15, 17, 18, 19, ----- 2-4, 6-9, 13, 16, 20 and 21
Y	US 2,751,073 A (SHEERAN) 19 June 1956, Figs. 1 and 2	6-9, and 16
Y	US 5,336,123 A (LASKE ET AL.) 09 August 1994, Figs. 1 and 5	8, 9
Y	US 958,647 A (JONES) 17 May 1910, Figs. 1-3	2, 20 and 21
Y	US 2,745,590 A (HERZOG ET AL.) 15 May 1956, Fig. 1	3



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

30 JANUARY 2000

Date of mailing of the international search report

14 FEB 2000

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US99/21873

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3,514,157 A (GEISER) 26 May 1970	
A	US 3,398,501 A (ANINGER) 27 August 1968	